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(19) (CA) **APPLICATION FOR CANADIAN PATENT** (12)

(54) **Propionic Acid Fermentation Product and Soy Bean Fermentation Product Obtained Using the Same**

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Notice: This application is as filed and may therefore contain an incomplete specification.



ABSTRACT OF THE DISCLOSURE

The present invention provides a propionic acid fermentation product by propionic acid fermentation of the lactic acid fermentation solution which is obtained by steaming a hull removed soy bean powder, digesting the steamed soy bean powder with an enzyme, and then fermenting the powder with lactic acid. The present invention also provides a soy bean fermentation product obtained by mixing the propionic acid fermentation product with the yeast fermentation product obtained by further inoculating a yeast into the lactic acid fermentation solution and culturing the yeast.

Lactobacillus bulgaricus and Streptococcus thermophilus as lactic acid bacteria, and Propionibacterium shermanii as propionic acid bacteria are used for forming the propionic acid fermentation product and the soy bean fermentation product. The present invention can completely remove the odor of the soy bean raw material and the odor of the steamed soy beans, and can completely prevent the growth of mold.

PROPIONIC ACID FERMENTATION PRODUCT AND SOY BEAN
FERMENTATION PRODUCT OBTAINED USING THE SAME

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a propionic acid fermentation product and a soy bean fermentation product obtained using the propionic acid fermentation product from both of which the odor of soy beans as a raw material and the odor of steamed soy beans are completely removed within a short time, and which are completely kept from getting moldy.

Description of the Related Art

A conventional soy bean fermentation product has the problems that the odor of soybeans remains, and that the product easily gets moldy.

A known soy bean product without the odor of soy beans is disclosed in, for example, Japanese Patent Publication No. 59-48621. In this specification, hull removed soy beans are finely ground to form a whole soy bean powder having high enzyme activity, the thus-formed soy bean powder is then treated with water vapor (steamed) for destroying the enzyme and removing the volatile components of the soy beans, dissolved in water and then subjected to lactic acid fermentation, and a

yeast is added to the resultant lactic acid fermentation solution to obtain a soy bean fermentation product.

However, when the steamed soy beans are fermented only with lactic acid and a yeast, the fermentation product obtained easily gets moldy during preservation.

SUMMARY OF THE INVENTION

The inventors found that when a soy bean fermentation product to which propionic acid bacteria are further added is fermented, the produced propionic acid can prevent the product from getting moldy. This finding resulted in the achievement of the present invention. In the present invention, propionic acid fermentation was made according to the method described in JOURNAL OF FERMENTATION AND BIOENGINEERING Vol. 74, No. 2, 95-99, 1992.

An object of the present invention is to prevent the generation of the odor of soy beans and the growth of mold by reacting a hull removed soy bean powder with an enzyme, lactic acid bacteria and propionic acid bacteria or further reacting the reacted powder with a yeast.

The present invention provides a propionic acid fermentation product through the following steps (1) to (3):

(1) the step of steaming a hull removed soy bean powder and then digesting the steamed soy bean powder with an enzyme;

(2) the step of inoculating Lactobacillus bulgaricus and Streptococcus thermophilus into the enzyme digestion product obtained in the step (1) and then culturing the bacteria; and

(3) the step of inoculating Propionibacterium shermanii into the lactic acid fermentation product obtained in the step (2) and then culturing bacteria.

The present invention also provides a soy bean fermentation product, using the propionic acid fermentation product, by mixing the propionic acid fermentation product (A) and the yeast fermentation product (B), both of which are obtained through the following steps (1) to (3) and (a) to (c), respectively:

(A) propionic acid fermentation product

(1) the step of steaming a hull removed soy bean powder and then digesting the steamed soy bean powder with an enzyme;

(2) the step of inoculating Lactobacillus bulgaricus and Streptococcus thermophilus into the enzyme digestion product obtained in the step (1) and then culturing the bacteria; and

(3) the step of inoculating Propionibacterium shermanii into the lactic acid fermentation product obtained in the step (2) and then culturing the bacteria.

(B) yeast fermentation product

(a) the step of steaming a hull removed soy bean powder and then digesting the steamed soy bean powder with an enzyme;

(b) the step of inoculating Lactobacillus bulgaricus and Streptococcus thermophilus into the enzyme digestion product obtained in the step (a) and then culturing the bacteria; and

(c) the step of inoculating a yeast into the lactic acid fermentation product obtained in the step (b) and then culturing the yeast.

In the production of the propionic acid fermentation product and the soy bean fermentation product of the present invention, the fine powder of hull removed soy beans serving as a medium is degraded by an enzyme which originates in Aspergillus Oryzae before propionic acid fermentation starts. Lactobacillus bulgaricus and Streptococcus thermophilus are then caused to live in symbiosis in the soy bean digestion product. Alternatively, both the lactic acid bacteria and a yeast may be inoculated into the

digestion product and cultured. Since the fermentation product thus contains complicated nitrogen compounds, pantothenic acid and vitamin such as biotin and the like, which are essential for growth of the propionic acid bacteria, propionic acid fermentation which was formerly unstable stably proceeds.

In propionic acid fermentation (the fermentation product and the soy bean fermentation product) according to the present invention, the addition of a small amount of yeast extract stabilizes the molar ratio of 2 : 1 between propionic acid and acetic acid. In addition, since two kinds of lactic acid bacteria and propionic acid bacteria are caused to live in symbiosis, the production of volatile acids is promoted, and the consumable substrate, i.e., lactic acid, is produced by equilibrium fermentation, thereby obtaining propionic acid and acetic acid from the lactic acid with a high yield of about 75 %.

In the production of the propionic acid fermentation product and the soy bean fermentation product according to the present invention, the test below was performed for determining the amounts of pantothenic acid and biotin which were produced by lactic acid fermentation and yeast fermentation before propionic acid fermentation.

200 parts of sterilized water and 0.02 part of Aspergillus Oryzae enzyme were added to 100 parts of steamed soy bean powder, followed by enzyme digestion and lactic acid fermentation.

As a result, it was found that 0.25 mg/100 g pantothenic acid and 6.2 μ g/100 g of biotin were produced in the lactic acid fermentation product. It was expected from this result that the propionic acid fermentation easily proceeds.

The thus-obtained propionic acid fermentation solution and the soy bean solution obtained by enzyme digestion were mixed with the product obtained by further lactic acid fermentation and yeast fermentation of the digested soy bean solution. The resultant mixture was aged for about 10 days to form a cheese-like fermented food. As a result of the taste of this food, it was impossible to feel the odor of soy beans and the odor of steamed soy beans.

Further, the soy bean fermentation product obtained using the propionic acid fermentation product according to the present invention prevents the growth of mold. The addition of the soy bean fermentation product containing calcium carbonate (CaCO_3) to a bread material in the bread forming process thus prevents the growth of mold, improves the flavor of bread and the suitability

for forming bread based on extensograph, and produces calcium-enriched food.

DETAILED DESCRIPTION OF THE INVENTION

The present invention is described in detail below with reference to examples.

EXAMPLE

Example 1

77.9 % sterilized water and 0.02 % of enzyme originating in Aspergillus Oryzae were added to 20 % hull removed soy bean powder which was previously steamed for 20 minutes to form a lactic acid fermentation solution as a medium. After the solution was digested at 40°C for 30 minutes, 2 % of starter which was inoculated with Lactobacillus bulgaricus and Streptococcus thermophilus was added to the solution, followed by culture at 37°C for 5 hours. The resultant lactic acid fermentation solution was then diluted by 4 times, and 0.05 % of yeast extract was further added to the diluted solution to form a medium for propionic acid bacteria. When Propionibacterium shermanii was inoculated into the thus-formed medium, propionic acid and acetic acid were produced with ratios of 0.81 % and 0.43 %, respectively, relative to 2 % of lactic acid contained in the medium. The medium was then subjected

to culture at 30°C for 8 days. When fermentation was further continued, the yield was increased.

Example 2

77.9 % sterilized water and 0.05 % of enzyme originating in Aspergillus Oryzae were added to 20 % hull removed soy bean powder which was previously steamed for 20 minutes to form a lactic acid fermentation solution as a medium. After the solution was digested at 40°C for 30 minutes, 2 % of starter which was inoculated with Lactobacillus bulgaricus and Streptococcus thermophilus was added to the solution, followed by culture at 37°C for 5 hours. The resultant lactic acid fermentation solution was then diluted by 4 times, and 1 % of calcium carbonate and 0.1 % of yeast extract were further added to the diluted solution to form a medium for propionic acid bacteria. When Propionibacterium shermanii was inoculated into the thus-formed medium, propionic acid and acetic acid were produced with ratios of 0.93 % and 0.47 %, respectively, relative to 2 % of lactic acid contained in the medium. The medium was then subjected to culture at 30°C for 12 days. When fermentation was further continued, the yield was increased.

Example 3

65.9 % sterilized water and 0.02 % of enzyme originating in Aspergillus Oryzae were added to 30 % hull removed soy bean powder which was previously steamed for 20 minutes to form a lactic acid fermentation solution as a medium. After the solution was digested at 30°C for 30 minutes, 2 % of starter which was inoculated with Lactobacillus bulgaricus and Streptococcus thermophilus was added to the solution. 30 minutes after, 2 % of Sacchromyces cerevisiae was further inoculated into the solution, followed by culture at 35 to 37°C for 4 hours. 100 parts of the fermentation solution cooled to 15°C was mixed with 20 parts of the propionic acid fermentation solution obtained in Example 1, and the resultant mixture was then aged for 7 days to form a product.

Example 4

65.9 % sterilized water and 0.02 % of enzyme originating in Aspergillus Oryzae were added to 30 % hull removed soy bean powder which was previously steamed for 20 minutes to form a lactic acid fermentation solution as a medium. After the solution was digested at 38°C, 2 % of starter which was inoculated with Lactobacillus bulgaricus and Streptococcus thermophilus was immediately added to the solution. 30 minutes after, 2 % of Sacchromyces

cerevisiae was further inoculated into the solution, followed by culture at 35 to 38°C for 4 hours. 1 part of the fermentation solution cooled to 30°C was mixed with 1 part of the propionic acid fermentation solution obtained in Example 2, followed by aging for 7 days. The resultant product was adjusted to pH 5 by calcium carbonate, and then dried to form a product.

The propionic acid fermentation product obtained in each of Examples 1 to 4 and the soy bean fermentation product obtained using the propionic acid fermentation product were mixed at an appropriate ratio, and the resultant mixture was aged for about 10 days to form cheese-like fermented food. As a result of taste of this food, it was impossible to feel the odor of soy beans and the odor of steamed soy beans.

Further, the propionic acid fermentation product obtained in each of Examples 1 to 4 and the soy bean fermentation product obtained using the propionic acid fermentation product prevented the growth of mold. The addition of the soy bean fermentation product containing calcium carbonate (CaCO_3) to a bread material in the bread forming process thus prevented the growth of mold, improved the flavor of bread and the suitability for forming bread based on extensograph, and produced calcium-enriched food.

WHAT IS CLAIMED IS:

1. A propionic acid fermentation product obtained through the following steps (1) to (3) of:

(1) steaming a hull removed soy bean powder and then digesting the steamed soy bean powder with an enzyme;

(2) inoculating Lactobacillus bulgaricus and Streptococcus thermophilus into the enzyme digestion product obtained in the step (1) and then culturing the bacteria; and

(3) inoculating Propionibacterium shermanii into the lactic acid fermentation product obtained in the step (2) and then culturing the bacteria.

2. A soy bean fermentation product obtained, using a propionic acid fermentation product, by mixing a propionic acid fermentation product (A) with a soy bean fermentation product (B), both of which are obtained through the following steps (1) to (3) and (a) to (c), respectively, of:

(A) propionic acid fermentation product

(1) steaming a hull removed soy bean powder and then digesting the steamed soy bean powder with an enzyme;

(2) inoculating Lactobacillus bulgaricus and Streptococcus thermophilus into the enzyme digestion

product obtained in the step (1) and then culturing the bacteria; and

(3) inoculating Propionibacterium shermanii into the lactic acid fermentation product obtained in the step (2) and then culturing the bacteria.

(B) soy bean fermentation product

(a) steaming a hull removed soy bean powder and then digesting the steamed soy bean powder with an enzyme;

(b) inoculating Lactobacillus bulgaricus and Streptococcus thermophilus into the enzyme digestion product obtained in the step (1) and then culturing the bacteria; and

(c) inoculating a yeast into the lactic acid fermentation product obtained in the step (b) and then culturing the yeast.

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SECTION is not Present
Cette Section est Absente